

*Culicoides* (Diptera: Ceratopogonidae) from Salem County,  
New Jersey<sup>1</sup>

SUJIT KUMAR DASGUPTA<sup>2</sup> AND ELTON J. HANSENS<sup>3</sup>

RUTGERS—THE STATE UNIVERSITY, NEW BRUNSWICK, NEW JERSEY

**Abstract:** Collections of Ceratopogonidae were made in Salem County, New Jersey by means of mosquito light traps operated daily at five locations from June through August. Species of *Culicoides* collected in order of decreasing frequency were *C. variipennis*, *C. venustus*, *C. stellifer*, *C. hollensis*, *C. crepuscularis*, *C. biguttatus*, *C. sanguisuga*, *C. arboricola*, *C. melleus*, *C. piliferus*, and *C. villosipennis*. Collection of *C. arboricola*, and *C. piliferus* are new records for New Jersey. Detailed analysis of taxonomic features are given for the first eight of these species.

Studies on the biting midges (*Culicoides*) in New Jersey have been very limited. Smith (1899) included only species, *Culicoides variipennis*, in his list of insects of New Jersey. Foote and Pratt (1954) added five more species and Fox (1955) listed six species from New Jersey. More recently Burbutis and Jobbins (1964) reported a total of 15 species from the state as follows: *C. baueri* Hoffman, *C. biguttatus* (Coquillet), *C. crepuscularis* Malloch, *C. furens* (Poey), *C. guttipennis* (Coquillet), *C. hollensis* (Melander and Brues), *C. melleus* (Coquillet), *C. obsoletus* (Meigen), *C. sanguisuga* (Coquillet), *C. spinosus* Root and Hoffman, *C. stellifer* (Coquillet), *C. testudinalis* Wirth and Hubert, *C. variipennis* (Coquillet), *C. venustus* Hoffman, and *C. villosipennis* Root and Hoffman.

In the summer of 1956 collections of Ceratopogonidae were made at five locations in Salem County, New Jersey, using standard mosquito light traps. A total of 3,909 biting midges were taken, including 505 *Culicoides*. In the present study the *Culicoides* have been studied in detail. Ten species previously reported from New Jersey were collected. Two new records for the state were the collection of *C. arboricola*, Root and Hoffman, and *C. piliferus*, Root and Hoffman. Details of morphological characters were studied on those species which were taken in large numbers.

**METHODS.** The traps at the five locations were operated from 7:00 P.M. to 7:00 A.M. as follows: Two traps, one at the barn and the other about 250 feet away near the cottage, were operated at the Haynes farm on the Fort Elsinboro Road 2½ miles southwest of Salem; a third trap was located about 1 mile to the north at the Ritchie farm. Trap 4 (Gardner) was operated in a residential

<sup>1</sup> Paper of the Journal Series, New Jersey Agricultural Experiment Station, Rutgers—The State University. Department of Entomology and Economic Zoology.

<sup>2</sup> Present address, Department of Entomology, University of Maryland, College Park, Maryland.

<sup>3</sup> Research Specialist in Entomology.

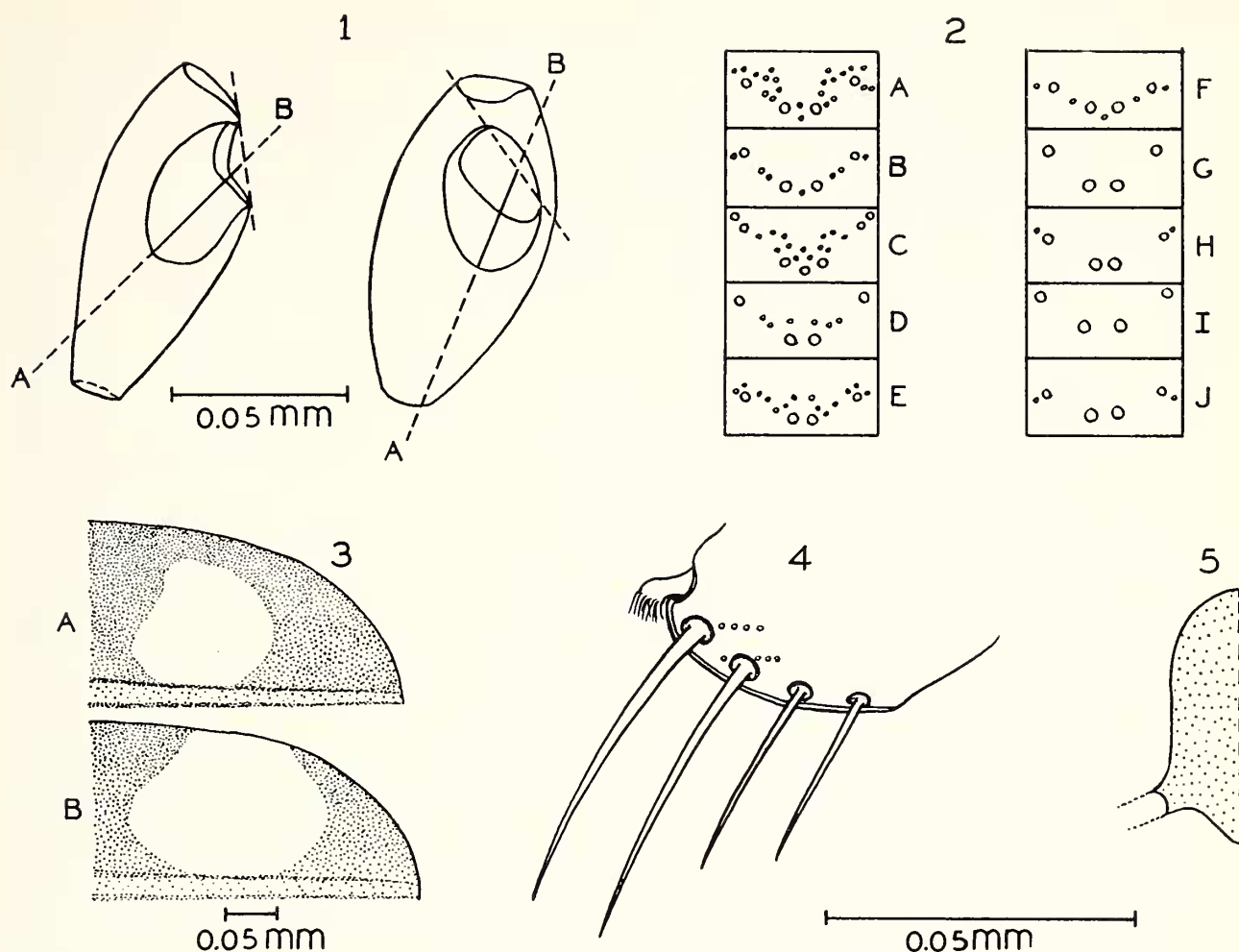


FIG. 1. Lateral (A) and dorsal (B) views of the third segment of the maxillary palp of *C. crepuscularis* (female) showing measurement (solid part of line a-b) of the sensory pit.

FIG. 2. Diagrams of alveoli of bristles on the scutellum. A. *C. arboricola*, B. *biguttatus*, C. *crepuscularis*, D. *furens*, E. *hollensis*, F. *piliferus*, G. *sanguisuga*, H. *stellifer*, I. *variipennis*, and J. *venustus*.

FIG. 3. Two patterns of distal pale spot in cell R<sub>5</sub> of *C. crepuscularis* (female).

FIG. 4. Hind tibial comb of *C. crepuscularis* (female) showing difference in length of spines of the comb.

FIG. 5. Spermatheca of *C. crepuscularis* showing unsclerotized beginning of the spermathecal duct.

area of the city of Salem, and Trap 5 (Richman farm) was on New Jersey highway 45, 5 miles northeast of Salem.

The Ceratopogonidae collected by the traps were preserved dry in pill boxes. For taxonomic study the specimens were treated in hot carbolic acid until proper distension was obtained and then were dissected under the microscope for mounting on slides in the best position to show taxonomic details. Permanent mounts were prepared with phenoleuparol mixture. Where long series of specimens were available only a portion was given this detailed treatment; part of the specimens were identified in the dry state. Terminology used in taxonomic descriptions followed the practice of Wirth and Blanton (1959) and Jamnback and Wirth (1963). Both distribution of antennal sensoria and the number of

TABLE 1. Collections of Ceratopogonidae in five light traps, Salem County.

Species	Trap 1	Trap 2	Trap 3	Trap 4	Trap 5	Total	Per cent of <i>Culicoides</i>
Nights collected	35	24	26	51	46		
Total Ceratopogonidae	800	602	695	598	1,212	3,909	
Total <i>Culicoides</i>	101	32	29	46	297	505	
<i>variipennis</i>	8		1		104	113	22.4
<i>venustus</i>	5			1	97	103	20.4
<i>stellifer</i>	33	3	2	14	48	100	19.8
<i>hollensis</i>	30	10	14	16	9	79	15.6
<i>crepuscularis</i>	4	13	7	4	15	43	8.5
<i>furens</i>	10	5	5	9	4	33	6.5
<i>biguttatus</i>	7			2	9	18	3.6
<i>sanguisuga</i>	3	1			7	11	2.2
<i>arboricola</i>					2	2	0.4
<i>melleus</i>	1					1	0.2
<i>piliferus</i>					1	1	0.2
<i>villosipennis</i>					1	1	0.2

sensoria per segment were noted. The depth of the sensory pit (Fig. 1) in the third segment of the maxillary palp was measured. The scutellar bristles were recorded by plotting the distribution of their alveoli. When the number of alveoli was low, the count and distribution were quite constant for a species, but when the number of alveoli was more than ten, only the distribution pattern was dependable. Intra-specific differences were small in such characters as proboscis length, head-length index, and depth of sensory pit. Illustrations were drawn with the aid of camera lucida, except for schematic diagrams of the scutellar bristles.

RESULTS. The numbers of each of the 12 species of *Culicoides* collected are listed by trap location in Table 1. The total number of each species for all traps, and an expression of it as a per cent of the total number of *Culicoides* collected, are also shown in Table 1. Four species, *C. hollensis*, *C. stellifer*, *C. variipennis*, and *C. venustus*, made up 78% of these collections. Two species (*C. variipennis* and *C. venustus*) were found almost entirely at trap 5, the location most distant from salt marsh areas.

Compared with other Ceratopogonidae, the numbers of *Culicoides* taken in these traps was surprisingly small. Preliminary examination of other Ceratopogonidae shows that most of the insects belong to 5 genera: *Atrichopogon* Kieffer, *Dasyhelea* Kieffer, *Forcipomyia* Meigen, *Bezzia* Kieffer, and *Stilobezzia* Kieffer.

In these collections, females made up 91% of the *Culicoides*; for 6 species, including *C. hollensis*, the fourth most abundant, no males at all were taken. Four species were taken at all five locations. Only one or two individuals of each of the four least common species (*C. arboricola*, *C. piliferus*, *C. melleus*,

and *C. villosipennis*) were taken and these were all taken at only one location.

Although the numbers of *Culicoides* collected were not large, a combination of all the data from all traps (Table 2) for the 5 most common species shows them all to be present from June 23 (when collections began) to August 31. *C. venustus* seems to appear later than the others and *C. variipennis* dies off in the last half of August. From the data available it is impossible to determine whether there are several broods of the various species.

**TAXONOMIC CONSIDERATIONS.** Sufficient specimens from each of the following 8 species were available for detailed taxonomic measurements, expressed in mm as averages and range.

*C. biguttatus.* Wing length 1.37 (1.35–1.39), breadth 0.55 (0.54–0.57) and costal length 0.89 (0.86–0.91); mandible teeth number 15.8 (14–17); ratio of proboscis length to head length index 0.78; palp segments in the proportion 8:22:25:14:13, palpal ratio 2.6 (2.5–2.7); antenna with sensoria on III (2–3), VII (1), and IX, XV (1 on each), missing occasionally (9%) from IX–X, while flagellar segments are in the proportion 25:15:16:17:18:18:18:18:25:25:27:30:40; 2 functional spermathecae measure (length  $\times$  breadth): 0.067  $\times$  0.053, and 0.063  $\times$  0.05.

Scutellar bristles 11 in number, 7 smaller ones with 1 at middle, between larger two, and 3 on each side (Fig. 2B).

*C. crepuscularis.* Wing length 1.46 (1.35–1.55), breadth 0.6 (0.54–0.64), and costal length 0.87 (0.84–0.9); mandible teeth number 14 (13–15); ratio of proboscis length to head length index 0.81; palp segments in the proportion 8:24:37:12:13, palpal ratio 2.17 (1.95–2.35), with sensory pit depth in III segment (Fig. 1) 0.028; antenna with sensoria on III (5–9), IV–XI (1–3, in each), and XII–XV (2–5, in each), missing occasionally (15%) from XV, while flagellar segments are in the proportion 16:12:12:13:13:14:14:14:26:26:30:30:35.

Scutellar bristles 20 in number, 13 smaller ones arranged in one central cluster (Fig. 2C).

Two distinct forms of wing maculation were noted in *crepuscularis*; those with comparatively small pale spots and those with larger ones. In 61.5% the apical pale spot in cell  $R_5$  does not touch wing margin; in the rest the spot touches the margin (Fig. 3A and B). No other significant difference between the two forms, however, was noted. Wirth (1952), in *crepuscularis* from California, and Foote and Pratt (1954) in those from the eastern United States, found only the large maculation. The continuous pale area just behind the second radial cell, continuous with the pale spot at r–m crossvein, noted in Florida material, was not seen in our collections.

The spines of the hind tibial comb of *crepuscularis* (Fig. 4) differ from Lewis' (1956) key to Nearctic *Culicoides* beyond the couplet no. 15. The difference between the first two spines is very small in *crepuscularis*, whereas in *furens*, *hollensis*, *melleus*, and *piliferus* the difference is gross.

Wirth (1952) notes that in *crepuscularis* the single spermatheca is continued into a sclerotized duct that extends nearly as long as the spermatheca. In our specimens, however, this duct is unsclerotized almost from its origin (Fig. 5).

*C. furens.* Wing length 1.18 (1.12–1.28), breadth 0.53 (0.51–0.55), and costal length 0.8 (0.78–0.83); mandible teeth number 15 (12–18); ratio of proboscis length to head length index 0.81; palp segments in the proportion 8:20:29:11:12, palpal ratio 2.73 (2.6–3.0), with sensory pit depth in III segment 0.009; antenna with sensoria on III (3), VII (1–2, in each), VIII–IX (2, in each), and X (2–3), while flagellar segments are in the proportion 17:14:13:

TABLE 2. Abundance of *Culicoides* through the season.

Collection Dates	Number collected				
	<i>C. variipennis</i>	<i>C. venustus</i>	<i>C. stellifer</i>	<i>C. hollensis</i>	<i>C. crepuscularis</i>
June 23-30	26	4	32	24	7
July 1-15	35	21	20	11	8
July 16-31	15	24	14	14	7
Aug. 1-15	27	20	17	10	14
Aug. 16-31	9	35	16	18	9

13:13:13:13:13:22:23:25:27:37; 2 functional spermathecae measure:  $0.046 \times 0.039$ , and  $0.043 \times 0.03$ .

Scutellar bristles 10 in number, 6 smaller ones more or less in a median transverse row (Fig. 2D).

Wing maculation varies with about 10% of the females showing a confluence of distal spots in cell  $R_5$  (Fig. 6) rather than separate spots (Fig. 7). Foote and Pratt (1954) figure macrotrichia only in cell  $R_5$ , whereas Wirth and Blanton (1959) show that they can be seen in all cells down to the anal cell and on branches of M and MCu veins. The dark streak above the MCu vein was not seen in wings of New Jersey specimens. The area just above the mediocubital fork looks pale in dry-mounted specimens, and a scrutiny of slide preparations reveals that this area contains only thinly set sclerotized microtrichia typical of dark areas in wings of *Culicoides* (Fig. 8).

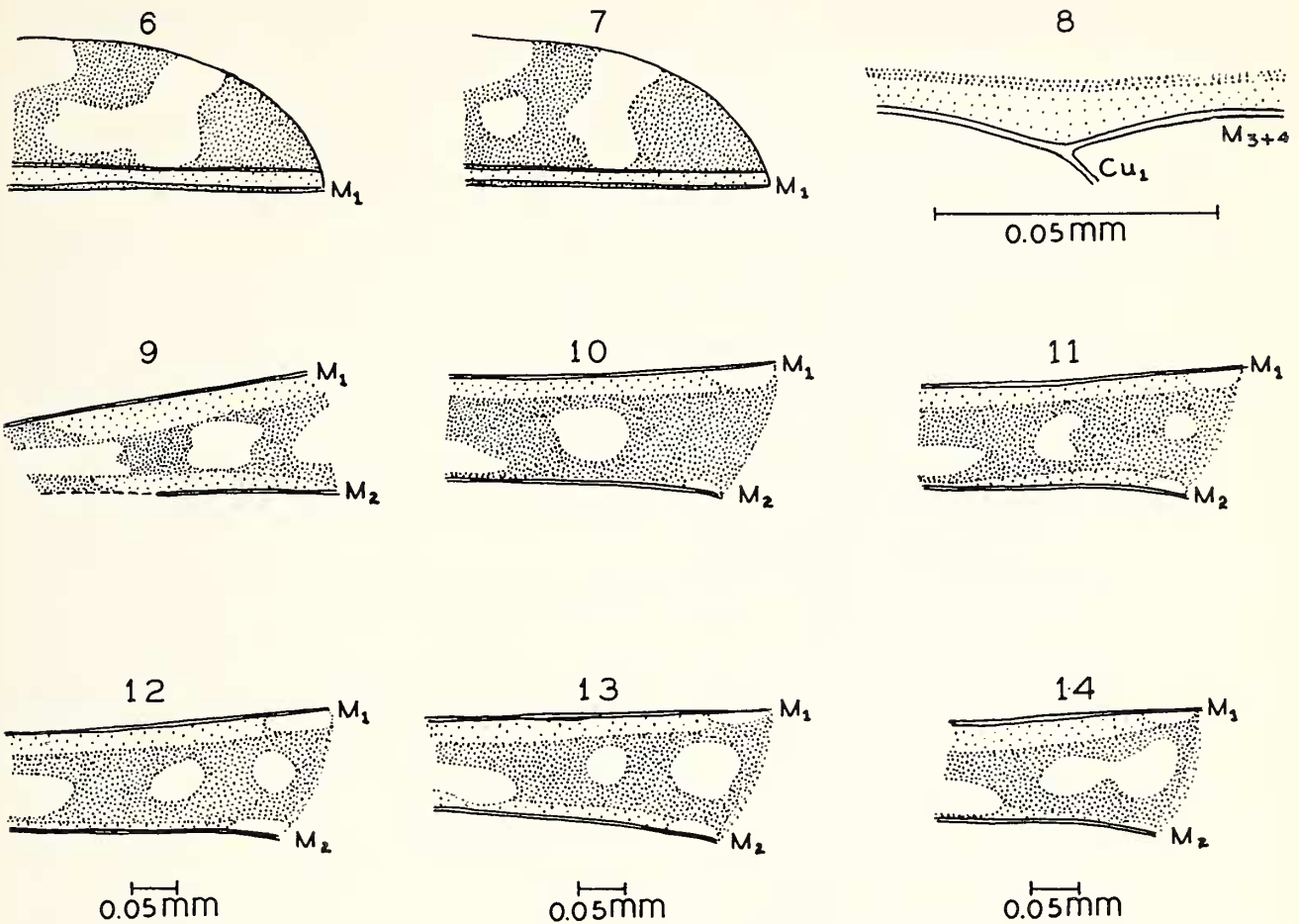
*C. hollensis*. Wing length 1.24 (1.17-1.33), breadth 0.48 (0.46-0.5), and costal length 0.82 (0.8-0.86); mandible teeth number 14.17 (13-16); ratio of proboscis length to head length index 0.89; palp segments in the proportion 9:22:25:12:10, palpal ratio 2.8 (2.76-2.81) with sensory pit depth in III segment 0.006; antenna with sensoria on III (1), and XIII-XV (1, in each), occasionally (3%) also on XII, while flagellar segments are in the proportion 18:12:12:12:13:13:13:13:19:20:22:24:34; 2 functional spermathecae measure:  $0.09 \times 0.075$ , and  $0.088 \times 0.073$ .

Scutellar bristles 18 in number, 14 smaller ones, except median two, arranged more or less in a V-shaped row across scutellum (Fig. 2E).

*C. sanguisuga*. Wing length 1.22 (1.14-1.38), breadth 0.51 (0.46-0.58), and costal length 0.77 (0.69-0.88); mandible teeth number 14.8 (13-16); ratio of proboscis length to head length index 0.77; palp segments in the proportion 6:19:19:9:10, palpal ratio 2.09 (2.0-2.34), with sensory pit depth in III segment 0.009; antenna with sensoria on III (3), and XI-XIV (1-2, in each), while flagellar segments are in the proportion 20:14:12:12:12:12:13:14:18:19:20:23:35; 2 functional spermathecae measure:  $0.005 \times 0.004$ , and  $0.004 \times 0.003$ .

Scutellar bristles 4 in number, all of larger type (Fig. 2G).

The difficulty of species diagnosis in the *obsoletus* group has been recently discussed by Jamnback and Wirth (1963), and it is evident that with this group from New Jersey, one will have to make the determination among 3 closely related species—*chiopterus* (Meigen), *obsoletus* (Meigen), and *sanguisuga* (Coquillet). Quantitative data for the 11 specimens show unmistakably they are *sanguisuga*, since such subtler details as wing length, mandible teeth number and ratio of proboscis length to head length fit the range known for *sanguisuga*. The configuration of the third palpal segment is also that of *sanguisuga*. However, while cell  $M_1$  bears 2 to 4 macrotrichia (average 3.2), the same as *sanguisuga*, vein  $M_1$  consistently shows a higher number of macrotrichia (average 12, range 8 to 15). In view of the relative unimportance of this feature, this discrepancy is ignored.



FIGS. 6-7. Separated and confluent patterns of distal pale spots in cell R<sub>5</sub> of *C. furens* (female).

FIG. 8. Sclerotized microtrichia above medio-cubital fork in wing of *C. furens* (female).

FIG. 9. Sclerotized microtrichia around 3 pale spots in cell M<sub>1</sub> of *C. stellifer* (female).

FIGS. 10-14. Various maculations of wing cell M<sub>1</sub> in *C. venustus*.

*C. stellifer*. Wing length 1.17 (1.03-1.22), breadth 0.5 (0.48-0.51), and costal length 0.73 (0.71-0.76); mandible teeth number 15.2 (14-16); ratio of proboscis length to head length index 0.76; palp segments in the proportion 6:16:20:6:8; palpal ratio 1.9 (1.82-2.0), with sensory pit depth in III segment 0.018; antenna with sensoria on III (2), and VIII-X (3-4), occasionally (33.3%) also on VII (2-3), while flagellar segments are in the proportion 16:13:13:13:14:14:14:14:17:20:21:22:33; 2 functional spermathecae measure: 0.05 × 0.38, and 0.045 × 0.033.

Scutellar bristles 6 in number, 2 smaller ones outer to two larger lateral bristles (Fig. 2H).

In wing maculation the 3 spots in cell M<sub>1</sub> are separated from each other throughout the series (Fig. 9).

*C. variipennis*. Wing length 1.81 (1.71-1.86), breadth 0.72 (0.67-0.74), and costal length 1.09 (1.06-1.11); mandible teeth number 15.1 (12-16); ratio of proboscis length to head length index 0.08; palp segments in the proportion 19:31:40:16:20, palpal ratio 2.91 (2.85-2.98), with sensory pit depth in III segment 0.015; antenna with sensoria on III (1-2), VIII-IX (2, in each), and X (3-4), while flagellar segments are in the proportion 26:19:19:19:19:18:17:18:21:22:22:25:45.

Scutellar bristles 4 in number, all of larger type (Fig. 21).

Data given above indicate that the specimens belong to var. *variipennis* (Coquillet), since

they show values of wing length, mandible teeth number, palpal ratio, and sensoria distribution in antennae peculiar to this variety. Further, they show other characters typical of var. *variipennis*. None of the material examined showed a distal pale spot in cell  $M_1$  touching the wing margin. In dorsal aspect of their mesonotum, blackish dots are copious. Male genitalia all show a bare aedeagus and paramere tips impressively arched away from each other at middle, while the female spermatheca shows up as a characteristically U-shaped body, two limbs virtually touching each other.

*C. venustus*. Wing length 1.55 (1.48–1.66), breadth 0.64 (0.62–0.68), and costal length 1.06 (1.02–1.11); mandible teeth number 14 (12–16); ratio of proboscis length to head length index 0.74; palp segments in the proportion 7:22:28:11:15, palpal ratio 2.53 (2.5–2.73); antenna with sensoria on III (3–5), XI–XIII (1–2, in each), and XIV–XV (2–3, in each), with occasionally (45%) on V–VII and IX (1–2, in each), while flagellar segments are in the proportion 21:18:19:20:20:19:20:20:27:28:30:35:46; 2 functional spermathecae measure:  $0.048 \times 0.04$ , and  $0.043 \times 0.035$ .

Scutellar bristles 6 in number, 2 smaller ones outer but a little caudad to two larger, lateral bristles (Fig. 2J).

Wing maculation of the material studied presents a striking point in respect to the two distal pale spots in cell  $M_1$ . In 44.4% of the specimens, the distal-most pale spot is lacking (Fig. 10); when it is present, it may show up in four different forms (Figs. 11–14) but most often as a small pale spot. Those lacking spots consistently bear darker wings, more mandibular teeth, and less extra sensoria-bearing segments in their antennae. Those with the spot are smaller (average wing length 1.5) than those without the spot (average length 1.65). These differences require study in a larger series of specimens to assess their bearing on intra-specific variations.

#### Literature Cited

- BURBUTIS, P. P., AND D. M. JOBBINS. 1964. Notes on the *Culicoides* of New Jersey. *Mosquito News* **24** (4): 447–448.
- FOOTE, R. H., AND H. D. PRATT. 1954. The *Culicoides* of the Eastern United States (Diptera, Heleidae). U. S. Publ. Health. Monograph **18**: 1–53.
- FOX, I. 1955. A catalogue of the blood sucking midges of the Americas (*Culicoides*, *Leptoconops* and *Lasiohelea*) with keys to the subgenera and nearctic species, a geographic index, and bibliography. *J. Agric. Univ. Puerto Rico* **39** (4): 214–285.
- JAMNBACK, H., AND W. W. WIRTH. 1963. The species of *Culicoides* related to *obsoletus* in Eastern North America (Diptera: Ceratopogonidae). *Ann. Ent. Soc. Amer.* **56**: 185–198.
- LEWIS, F. B. 1956. On the tibial comb of the Ceratopogonidae (Diptera) and its use in the determination of the Nearctic species of *Culicoides*. *Canad. Ent.* **88** (9): 546–552.
- SMITH, J. B. 1900. Catalogue of insects of New Jersey. Supplement to N. J. State Board of Agric., 27th Ann. Rpt. p. 628.
- WIRTH, W. W. 1952. The Heleidae of California. *Univ. Calif. Publ. Ent.* **9** (2): 237–266.
- AND F. S. BLANTON. 1959. Biting midges of the genus *Culicoides* from Panama (Diptera: Heleidae). *Proc. U. S. Nat. Mus.* **109**: 237–482.
- AND R. H. JONES. 1957. The North American subspecies of *Culicoides variipennis* (Diptera, Heleidae). U. S. Dept. Agric. Tech. Bull. **1170**: 1–35.